The results are plotted in Figure 2 by verticals raised from each amount to the quantity, as indicated by the marginal scale, received from it in 12 seasons. It will be noted that amounts from 0.05 inch to 0.70 inch per day contribute approximately equal quantities to the total precipitation. In other words, within these limits the frequency of precipitation is inversely proportional to its quantity. In a period having 20 days of 0.05 inch precipitation each there will be 10 days of 0.10 inch, 5 days of 0.20 inch, 4 days of 0.25 inch, and so on. The number of precipitation days below 0.05 inch increases with decreasing quantities but not in the same proportion. Table 2 and Figure 1 show that the upper limit of 0.70 inch to which this relation is limited is the minimum in the Great Plains and does not apply to all stations. At North Platte and at Hays the point at which the curve breaks is reached at 1.10 inches, and at Washington, D. C., at 1.20 inches. On the other hand, the critical point in the curve is reached at 0.30 inch at both Moro and Nephi.

The marked depression in the smoothed curve at 0.60 inch is due to the fact that some of the stations did not receive precipitation in quantities of 0.59 inch, 0.61 inch, and 0.62 inch.

Above the critical point, which varies with the station, the decrease in the frequency of precipitations is more rapid than increase in quantity, so that the product of the number of precipitations in a given time and their amount is a constantly decreasing quantity.

NOTE ON ATMOSPHERIC HUMIDITY IN THE UNITED STATES.

By ROBERT DE C. WARD.

[Harvard University, Cambridge, Mass., Oct. 21, 1922.]

Relative humidity.—Atmospheric humidity has many important relations to life—human, animal, and vegetable. It, to a considerable degree, affects our bodily comfort; our feeling of heat or cold. It is one of the controlling climatic influences in the growth and develment of crops and of all forms of plant life. Both directly and indirectly, it affects many of our activities, our industries, our commercial organization. Relative humidity, i. e., the ratio between the amount of moisture in the atmosphere and the amount which could be present, without condensation, at the same termperature and under the same pressure, is a direct expression of the physical moisture or dryness of climate in relation to its temperatures. Relative humidity is a real and definite factor in climate. It is directly indicated by organic substances. It reacts upon them. For this reason the human hair is commonly used in measuring relative humidity in the hair hygrometer. Other organic substances, such as catgut or certain vegetable fibers, may also be used in the same way. The cracking or swelling of woodwork with decrease or increase in relative humidity is well known.

The general system followed by the lines of equal relative humidity is simple and easily remembered. (1) On the Pacific, Atlantic, and Gulf coasts the lines show a distinct tendency to parallel the seacoast. This feature is most clearly indicated on the Pacific slope, and there in the warmer months. (2) Over the interior plateau the lines group themselves in a general oval pattern around central or southern centers of minimum humidity. (3) Over the Great Plains lines of equal relative humidity lie more or less parallel with the meridians, especially in the central and southern sections. The geographical distribution of relative humidity, thus briefly outlined, depends on a number of controls. Among these (1) the temperature, (2) the direction of the prevailing winds, (3) the distance and direction of the chief source of moisture-supply, and (4) the topography are the most important.

The meridional trend of the relative humidity lines on the Great Plains was discovered by Loomis in 1880 in connection with his construction of the first chart of this kind for the United States.[1] The data upon which this pioneer chart was based related to a very few stations between latitudes 45° and 30° N., east of the Rocky Mountains, for January, 1875. Only four lines were drawn, viz, those for 50 per cent, 55 per cent, 60 per cent, and 65 per cent, but they were sufficient to indicate that "on the east side of these (Rocky) mountains there is a narrow belt of territory where the mean humidity is less than one-half; and there is a belt at least 400 miles wide where the mean humidity is less than two-thirds; and in advancing eastward we find the humidity to increase still further." This distribution is attributed to the fact that in crossing the Sierra Nevada the moisture, in the westerly winds, is "mostly condensed." "By passing over the Rocky Mountains there is a further condensation of vapor, so that when the air descends on the eastern side of these mountains it is almost destitute of moisture." The vapor brought from the Gulf of Mexico is diffused over the central lowlands and mixes with the dry air coming across the mountains from the west. Hence, in Loomis's opinion, the relative humidity must increase rapidly from the Rocky Mountains eastward.

Since Loomis's first attempt to draw relative humidity lines, numerous later charts have been published, covering all months as well as the year, and based on more and more complete data.[2]

The most complete discussion and cartographic and tabular presentation of the humidity element in the

[1] Elias Loomis: "Contributions to Meteorology, Being Results Derived from an Examination of the Observations of the United States Signal Service and from Other sources." *Amer. Journ. Sci.*, 3d ser. vol. 20, 1880, pp. 1-21. Pl. I.

[2] See, e. g., the following:

Frank Waldo: "Elementary Meteorology." 8 vo. New York, 1896. Fig. 114 shows average annual relative humidity in the United States, but no statement is made as to the source of the chart or the period covered by the observation.

H. A. Hazen: "The Distribution of Moisture in the United States." *Ann. Rept. Chief of Weather Bureau for 1897-98.* 4 to.

Washington, D. C., 1897, pp. 327-338: pls. VI, VII, diagrs. V-IX. The plates illustrate "waves of moisture, pressure, and temperature" for individual dates; the diagrams show fluctuations of dewpoint, of dewpoint and temperature, and diurnal range of moisture.

Frank H. Bigelow: "The Vapor Tension on the Sea Level, the 3,500-foot and the 10,000-foot Planes." *Ann. Rept. Chief of Weather Bureau for 1900-1901.* 4 to. Washington, D. C., 1902. Vol. II, pp. 420-422. Gives monthly and annual charts of relative humidity at sea level, and monthly and annual charts of normal vapor tension at sea level and on the 3,500-foot and the 10,000-foot planes.

Annual Report of the Chief of the Weather Bureau for 1901-02. 4 to. Washington, D. C. 1902, pp. 317-320. Three charts of normal relative humidity for January, July, and the year, based on data covering varying periods of time, from 4 to 14 years. Data given in tables. No author's name given, and no discussion.

Kenneth S. Johnson: "Mean Monthly and Mean Annual Relative Humidity Charts of the United States," *Rept. So. Afr. Assoc. Adv. Sci.*, 1906. 8 vo. Cape Town, 1907. pp. 161-168. Contains mean annual and mean monthly charts of relative humidity, based chiefly on the period 1888-1901, although in some cases shorter records were taken into account but given less weight. The data were not reduced to the true daily mean. Lines are drawn for differences of 10 per cent.

For tabulations and discussion of relative humidity data see, in addition to the above, the following:

W. B. Stockman: "Temperature and Relative Humidity Data." *U. S. Weather Bureau. Bulletin O.* 4 to. Washington, D. C., 1905. Pp. 29.

Alfred J. Henry: "Climatology of the United States." *U. S. Weather Bureau Bulletin.* Q 4 to. Washington, D. C., 1906. p. 61. Table VIII, pp. 106-109, contains the monthly mean values of relative humidity for 8 a. m. and 8 p. m., seventy-fifth meridian time, for a number of selected stations.

United States, based on the latest and most reliable data, is that of Preston C. Day, Chief of the Climatological Division of the Weather Bureau.[3]

With the exception of one set of maps[4] all the charts included in Day's monograph are to be found in the latest publication on humidity in the United States, the section on *Precipitation and Humidity* of the *Atlas of American Agriculture*.[5] In the *Atlas* the charts are on a smaller scale, and reproduced in colors, and a somewhat different selection of stations is made for purposes of illustrating, by means of curves, the annual march of humidity and vapor pressure.[6]

It is impossible to show the distribution of relative humidity over the United States satisfactorily and accurately by means of charts showing the mean monthly values, as can be done in the case of temperature or of rainfall. The most extensive series of observations available for about 200 regular Weather Bureau stations cover the period 1888–1913, and relate to 8 a. m. and 8 p. m., 75th meridian time (figs. 91–98, in *Atlas*). But the mean of such twice-daily observation does not always give the true daily mean, and the data are not strictly comparable for all parts of the country because of the difference in local time at which the observations were made, 8 a. m., 75th meridian time being 5 a. m. Pacific time.

To the west of the Rocky Mountains the 8 a. m. readings are found to approach the maximum for the day, and the 8 p. m. approach the minimum, the average of the two being close to the 24-hour mean. In the east, however, the 8 a. m. observations give values considerably higher than the daily means, and those for 8 p. m. are appreciably lower. With progress westward, owing to the earlier local time, the departures from the daily means become increasingly greater. The only extensive series of observations made at the same hour of local time (2 p. m.) covers the 5-year period, 1876–1880, for about 90 stations (figs. 85–88, in the *Atlas*, show the average relative humidity at 2 p. m., local time, for January, April, July, and October). But the period is short, the observations were not as carefully made as at present, and the psychrometric tables there used were not as accurate as those now employed. Hence the data are not considered to be directly comparable with averages for longer periods and for later years. It is pointed out that the 2 p. m. average relative humidity is not very different from the average minimum for the 24-hour period, the minimum, however, usually coming later than 2 p. m. and being a little lower. It is only in recent years that hygrograph records have been available for some Weather Bureau stations. With these exceptions, no direct observations of the daily minimum relative humidity have been made. For this reason the average daily minimum relative humidity has been computed for April, July, and October from the average 8 p. m., 75th meridian time, vapor pressure, and the saturation pressure corresponding to the average daily maximum temperature (figs. 98–101, *Atlas*). The lowest average daily minimum relative humidity is shown to be less than 15 per cent in southern Arizona, southwestern New Mexico, and extreme southwestern Texas in April. In July, as most of the Southern Plateau has less than 20 per cent, the highest values for the average minimum relative humidity are over 70 per cent on the extreme northwestern coast of Washington and at Cape Hatteras in July and in October, and over the eastern part of Cape Cod in October.[7]

The essential facts regarding the geographical distribution of mean annual relative humidity over the United States are shown in Figures 1–4. These are redrawn from the corresponding charts in the *Atlas of American Agriculture*, section on *Precipitation and Humidity*.

A belt of uniformly high relative humidity along the coasts averages about 75–80 per cent, and at certain seasons even exceeds 90 per cent on the North Pacific coast. This belt, from which there is a well-marked decrease inland, is in striking contrast with the far southwestern interior, in the lee of the Sierra Nevada Mountains, where the mean annual values are 50 per cent and even lower over parts of Nevada, Utah, Arizona, New Mexico, and southeastern California. The high humidities on the coast remain fairly constant throughout the year. The minima in the Great Basin, on the other hand, become distinctly more marked during the hot summers of that region, reaching 30 per cent and even 20 per cent over the districts of most extreme aridity. This seasonal change is clearly indicated in the annual migration of the lines of relative humidity. These travel northward as summer comes on, reach their northernmost limits in June or July, and then return southward again. Some of them even disappear entirely from the map in winter. Another striking effect of this seasonal variation is seen in the marked increase in summer of the relative humidity gradient between the damp southern Pacific coast and the interior deserts, east of the mountains.

Most of the eastern United States, inland from the coast and east of the Great Plains, runs about 70 to 75 per cent, with not very much seasonal variation. The plateau districts average, as a whole, some 10 to 20 per cent lower, with the seasonal changes just noted. The Plains are intermediate between the damper eastern and the drier southwestern sections. The distortion of the lines in the vicinity of the Great Lakes shows that these large bodies of water have similar effects to those of the oceans in increasing the relative humidity (75–80 per cent). This effect can be seen where stations on the lee side of one of the Lakes are compared with others on the windward side. Thus, Grand Haven, Mich., has a mean annual relative humidity of 78 per cent. Milwaukee, Wis., on the opposite shore of Lake Michigan, has 75 per cent. Davenport, Iowa, and St. Paul, Minn., farther west, have 72 per cent.[8]

[3] Preston C. Day: "Relative Humidities and Vapor Pressures over the United States, Including a Discussion of Data from Recording Hair Hygrometers." MONTH. WEA. REV., SUPPL. No. 6. 4 to. Washington, D. C., 1917. Pp. 61; charts; diagrs. The following relative humidity charts are included: Average relative humidity for January, April, July, and October at 8 a. m. and 8 p. m., 75th meridian time (25-year period, 1889 to 1913, inclusive); for January, April, July, and October at 3 and 11 p. m., 75th meridian time (period 188?–1886, inclusive); for January, April, July, and October at 2 p. m., local time (period 1876–1880, inclusive); average minimum relative humidity for April, July, and October (computed from the mean vapor pressure at 8 p. m., 75th meridian time, and saturation pressure for the mean daily maximum temperature). The diurnal and annual variation are shown by curves for selected stations and for different seasons. There are also charts showing the average depression of the wet bulb at the time of the daily maximum temperature for April, July, and October. These are to be discussed by the writer in a later article. The absolute humidity charts are considered at the end of the present paper. The set of "Climatic charts of the United States, published by the Weather Bureau, includes four charts showing lines of equal mean relative humidity for 8 a. m. and 8 p. m., 75th meridian time, for January and July. The observations used were those made at regular Weather Bureau stations during the 25-year period 1889–1913, inclusive, this period being the same as that in Day's charts.

[4] Those for 3 and 11 p. m. for January, April, July, and October.

[5] *Atlas of American Agriculture*. Prepared under the supervision of O. E. Baker, Agriculturist. Part II, Climate. Contribution from the U. S. Weather Bureau. Charles F. Marvin, Chief. Section A, Advance Sheets No. 5. *Precipitation and Humidity*. Prepared under the direction of P. C. Day, Climatologist, by J. B. Kincer, fol. Washington, D. C., 1922, pp. 45–47; figs. 85–106. Three charts showing the average depression of the wet-bulb temperature at the time of minimum relative humidity in April, July, and October will be discused in a later paper by the present writer.

[6] Compare Day's figs. 1–3 with fig. 89 of the *Atlas* section.

[7] The values for January were not computed, because of (1) the large temperature variability and (2) the frequency of temperatures below freezing.

[8] C. H. Eshleman: "Climatic Effect of the Great Lakes as Typified at Grand Haven, Mich." *Met. Chart of the Great Lakes* (U. S. Weather Bureau), Sept. 1913.

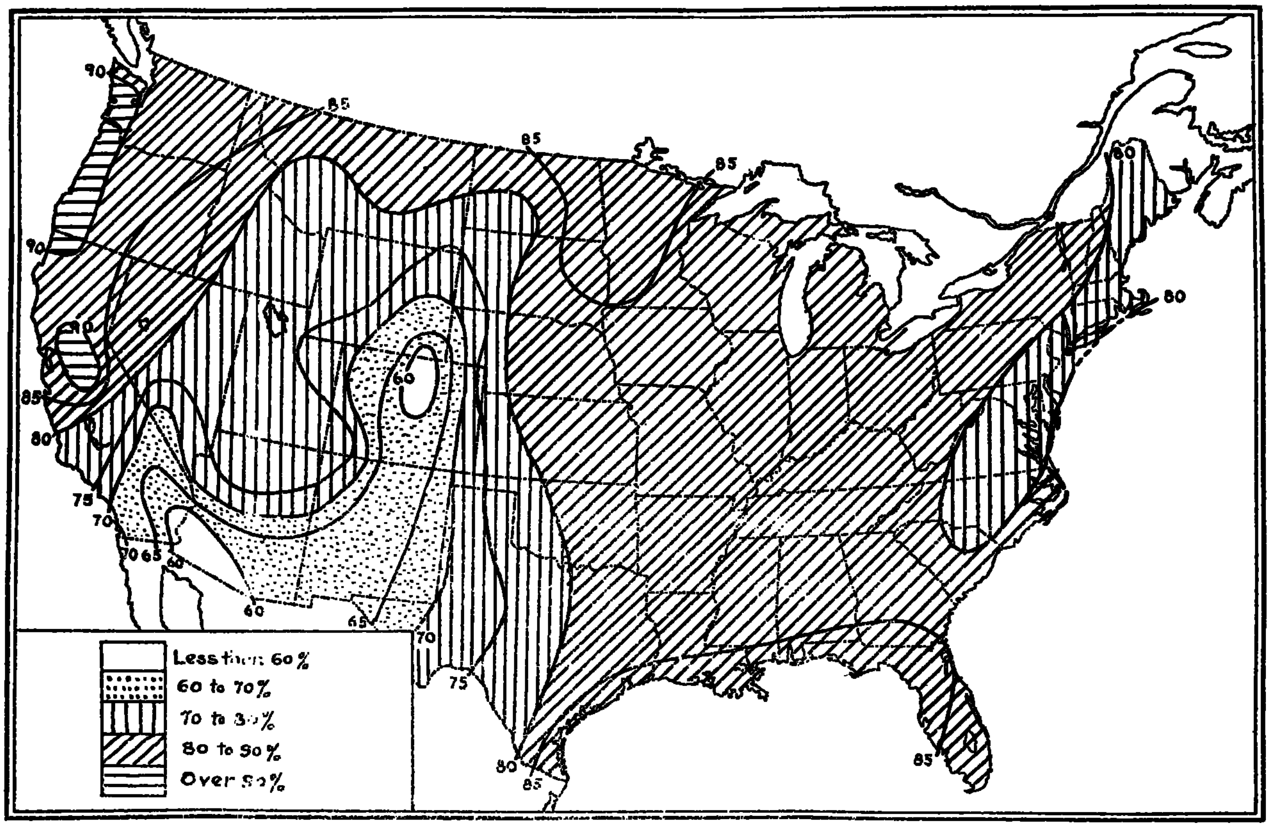

FIG. 1.—January average relative humidity, 8 a. m., 75th meridian time.

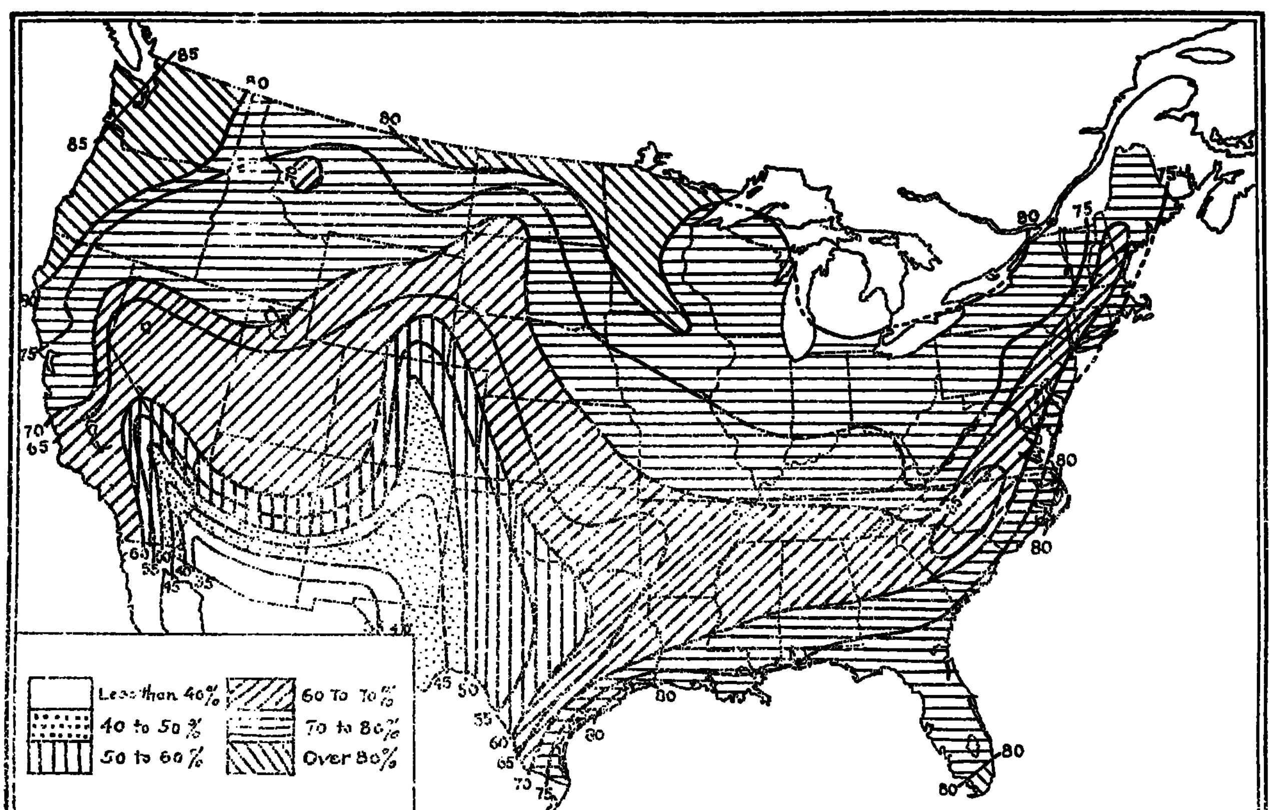

FIG. 2.—January average relative humidity, 8 p. m., 75th meridian time.

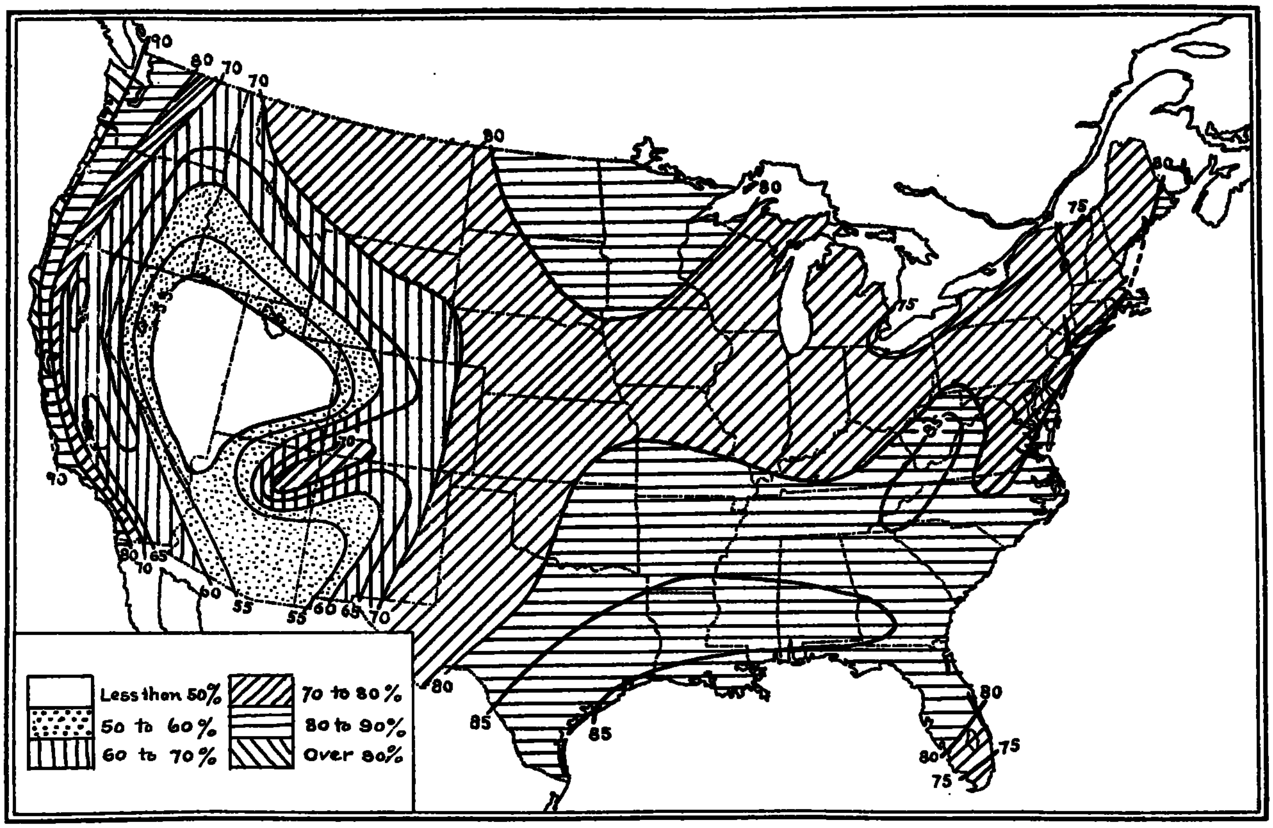

FIG. 3.—July average relative humidity, 8 a. m., 75th meridian time.

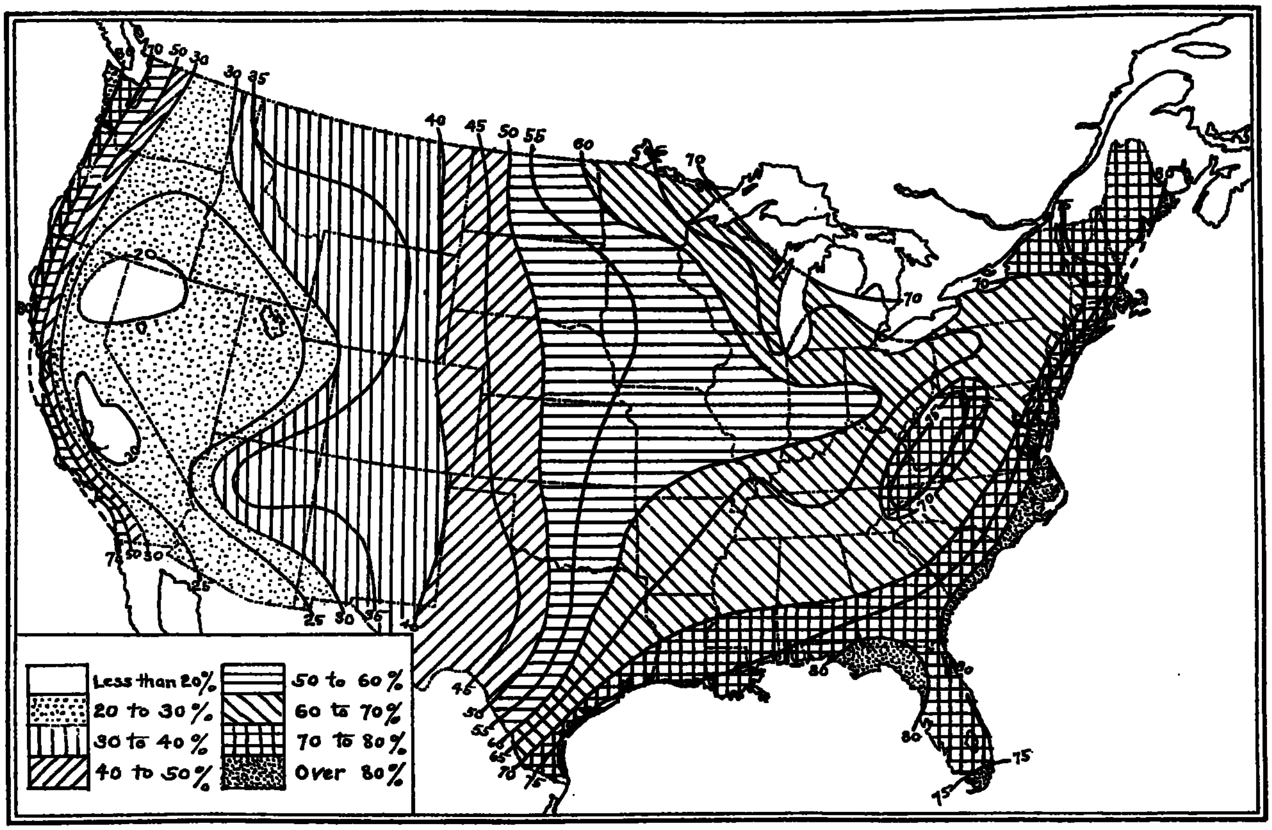

FIG. 4.—July average relative humidity, 8 p. m., 75th meridian time.

Another interesting fact, illustrating the effect of a mountain barrier upon the relative humidity on the windward and the leeward slopes, has been brought out by Day in the monograph already referred to.[9] In the cases of both Mount Washington, N. H., and Pikes Peak, Colo., the percentages of relatively humidity are continuously high. On the lee sides of these mountains the humidities are comparatively low, the obvious result of loss of moisture in the air passing over the mountains and of the decrease in humidity due to adiabatic warming of the air descending on the leeward side. Hence high relative humidities are to be expected generally on the windward sides of mountains and low values on the lee sides. These conditions are seen over the eastern sections of Colorado and Wyoming on the winter charts and also less clearly in the district just east of the Appalachians.

In both annual and diurnal periods relative humidity is, as a general rule, highest when the temperature is lowest and lowest when the temperature is highest. The curves when plotted together are directly the opposite of one another. April is generally the month of lowest relative humidity east of the Rocky Mountains, while to the west the midsummer months are driest. Over most of the country the highest relative humidities come in the colder months. In the southeast they may occur in late summer or early autumn. Elevated areas, as a rule, have comparatively high values without large seasonal and diurnal variations.

In his description of the climatology of the United States Hann refers to the fact that the air is drier in New England than in western Europe in districts of similar mean annual temperatures, a point first emphasized by Desor.[10] This lower humidity is explained as the result of the prevalence of offshore (NW.) winds in New England in winter. In summer, the prevailing winds are also offshore (SW., W.) and are much drier than those of Europe. Again, the annual variation of relative humidity and cloudiness, with a winter minimum and a summer maximum, found in the eastern coast of Asia, is not characteristic of the eastern coast of the United States. The prevailing winter offshore winds in the North American Atlantic coast are less emphatic and less regular than those of eastern Asia, being frequently interrupted by damp easterly cyclonic indrafts from the ocean.

Absolute humidity.—The actual amount of water vapor in the air is known as the absolute humidity. It is usually expressed in decimals of inches of pressure, and is then known as vapor pressure. Another way of expressing it is to give the actual weight of the moisture present in the air as so many grains in a cubic foot. Climatically considered, absolute is not as significant as relative humidity, for climates which are distinctly to be classed as "dry" may have as much moisture present in their atmosphere as is found in "moist" climates. Desert air is thus often absolutely moister than the air in a much damper region. On the other hand, as the actual vapor content of the air is frequently of considerable importance in industrial and in engineering undertakings, the data of vapor pressure are in many cases of real significance and value and need consideration in any complete description of climate. It is because of the greater meteorological, climatic, and physiological interest in relative humidity that the distribution and variation of absolute humidity has hitherto received the least attention.[11]

Recently, however, Day, in the report above referred to, has given attention to the distribution of absolute humidity, both in space and in time.[12]

In the new section on *Precipitation and Humidity* of the *Atlas of American Agriculture* charts and curves of absolute humidity are also included.[13]

Figures 5 and 6 redrawn from the *Atlas*, show the distribution of absolute humidity over the United States in January and in July.

Temperature is the chief control of absolute humidity. Therefore the lines of equal vapor pressure closely follow the isotherms. Other less important controls are the distance from large bodies of water, the wind direction, whether it be from or toward those sources of supply of vapor, and the intervening topography. In midsummer the amount of moisture in the atmosphere is generally from 2 to 4 times as large as in midwinter (compare figs. 5 and 6), the seasonal curve of vapor pressure as a rule closely following that of the temperature. In January (fig. 5), with the exception of the warm Gulf coasts, the absolute humidity is low, mainly because of the cold. In fact, it is about the same as that over the interior plateau in midsummer (fig. 6). The extremes are 0.05 inch in North Dakota, in a district of great cold, and 0.55 inch in Florida, where the temperatures are highest. From the district of minimum moisture there is an increase in all directions, roughly in proportion to the increasing temperatures. In July (fig. 6) the Gulf coast again has the maximum (about 0.85 inch), while the minimum (0.25 inch) has shifted from the northern Plains to the interior Western Plateau district. There is, therefore, again a close conformity to the distribution of temperature: an increase from north to south, as there is an increase from winter to summer. In southwestern Arizona, a dry desert climate, there is actually more moisture in the air in midsummer than there is in the moist climates around the Great Lakes. In the first-named district, however, the high summer temperatures and the resulting large capacity of the air for water vapor result in a low relative humidity, and the air is therefore dry. In the vicinity of the Great Lakes, on the other hand, with lower temperatures, the relative humidity is much higher than in Arizona, and the air is therefore relatively moist.

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[9] P. C. Day, *loc. cit*[8]. p. 10.

[10] J. Hann: "Handbuch der Klimatologie." 3d ed. 8 vo. Stuttgart, 1911, vol. 3, pp. 386-387. Desor pointed out in 1852 (*Proc. Boston Soc. Nat. Hist.*, vol. 4, 1851-1854, pp. 183-184) that because of this condition furniture made in Europe does not hold together well in New England.

[11] See e. g., H. H. C. Dunwoody: "Absolute Humidity and Mean Cloudiness in the United States represented by Tables and Charts." *Ann. Rept. Chief Signal Officer for 1884*. 8 vo. Washington, D. C. 1884. Appendix 9. pp. 128-129. Contains four charts of the seasonal distribution of absolute humidity in grains per cubic foot, based upon the observations of 1883 at regular Signal Service stations.

F. H. Bigelow: *loc. cit.*, footnote 2.

A. W. Greely: "American Weather." 8 vo. New York, 1888. Chap. V (Humidity and Evaporation) contains Charts XVIII and XIX showing mean absolute humidity in grains per cubic foot for January and July, based on data for 1876-1886.

Frank Waldo: "Elementary Meteorology." 8 vo. New York, 1896. Figs. 112, 113. The same charts as those of General Greely, just referred to.

Frank H. Bigelow: "Report on the Temperatures and Vapor tensions of the United States, reduced to a Homogeneous System of 24 Hourly Observations for the 33-year Interval, 1873-1903."

U. S. Weather Bureau Bulletin S. 4 to. Washington, D. C., 1909. p. 302.

[12] P. C. Day: *Loc cit*. Text, pp. 10-12; charts 27-34; figs. 1-6. The charts show the average vapor pressure in inches at 8 a. m. and 8 p. m., 75th meridian time, for January, April, July, and October (with the corresponding isotherms). The figures show the annual and diurnal march of vapor pressure at several selected stations and the ratios of the mean vapor pressures at 8 a. m. and 8 p. m., 75th meridian time, to their bihourly means for local standard time at three stations.

[13] *Loc. cit.*, footnote 4. Two charts (figs. 102, 106) show the average vapor pressure in inches for January and July, based on the mean of the 8 a. m. and 8 p. m. (75th meridian time) vapor pressures as observed at about 200 regular Weather Bureau stations. These means do not differ much from the 24-hour average. Fig. 89 shows, for selected stations, the annual march of vapor pressure. See also text, p. 45.

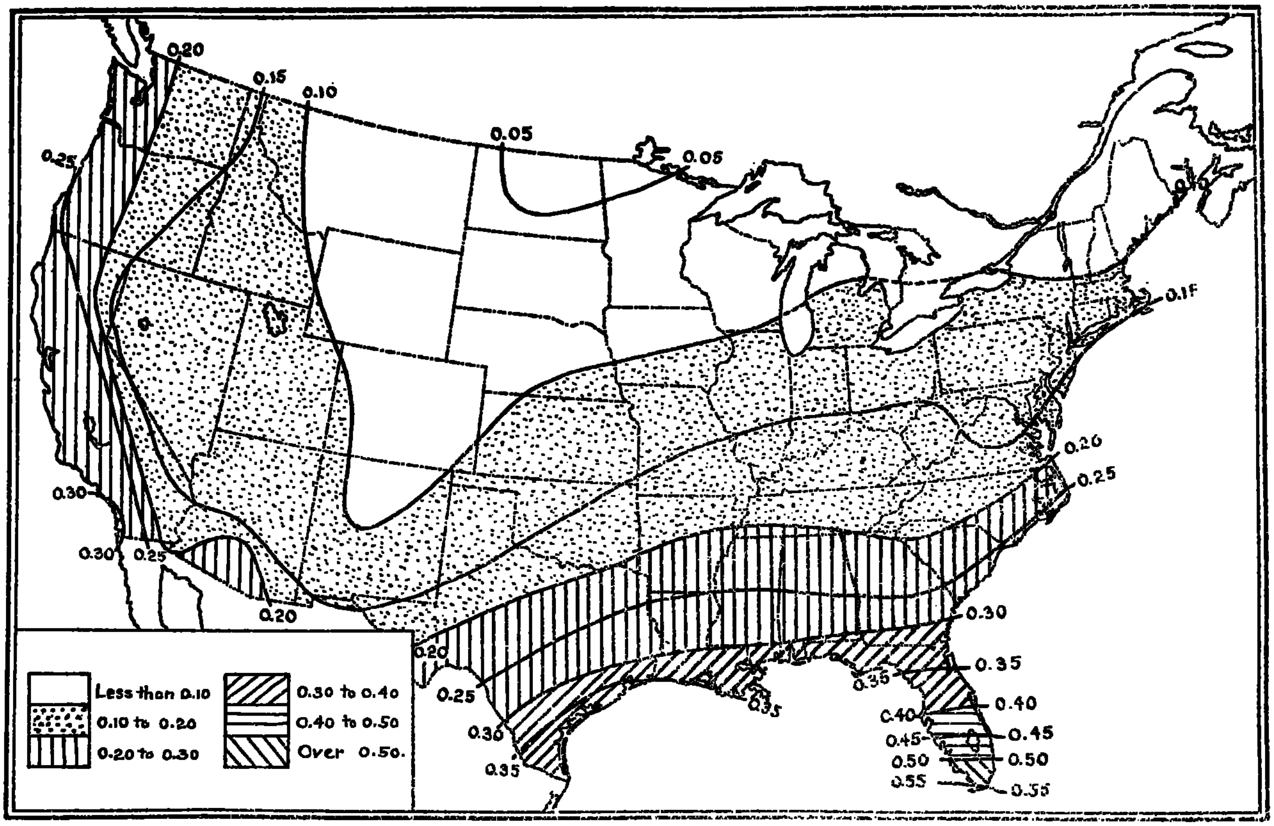

FIG. 5.—January average vapor pressure, in inches.

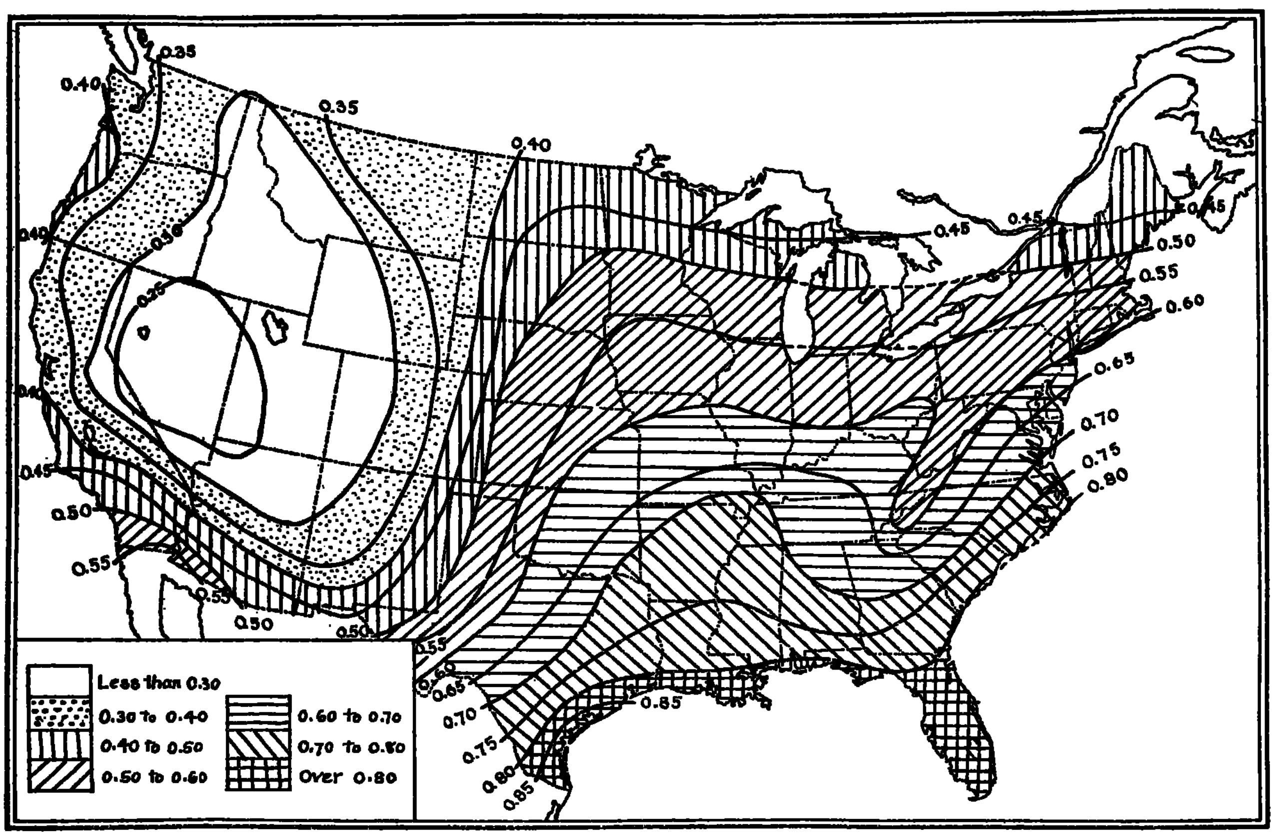

FIG. 6.—July average vapor pressure, in inches.

The diurnal variations in absolute humidity are chiefly dependent upon local conditions of evaporation from moist surfaces, and upon the balance between that source of supply of water vapor and any loss that takes place through condensation (dew, frost, etc.), all of these processes being largely under the control of temperature. Minima usually come at night, while maxima generally occur by day. All the interacting controls are subject to variations which depend upon permanent local conditions and upon temporary weather types.

CAUSE OF THE ACCELERATED SEA BREEZE OVER CORPUS CHRISTI, TEX.

By JOSEPH P. MCAULIFFE, Meteorologist.

[Weather Bureau, Corpus Christi, Tex., Sept. 12, 1922.]

SYNOPSIS.

The sea breeze at Corpus Christi attains unusually high velocities, becoming a fresh to strong southeast wind in the afternoon during summer. The same character of sea breeze is not to be found on either the northern or extreme southern Texas coast. The cause of this unusual sea breeze at this point is explained by reason of the topography of the hinterland of Corpus Christi and the contour of the coast line.

It has been established by observations extending over a period of 35 years and by comparison of average wind velocities on different parts of the Texas coast that the sea breeze attains unusually high velocities at Corpus Christi and its vicinity. This sea breeze comes from the southeast, usually begins after 8 a. m. and continues with increasing velocity during the day, frequently continuing as a moderate breeze throughout the night, but usually diminishing after midnight. It has an average velocity of 12 miles per hour at 10 a. m., when it usually becomes noticeable, and 19 miles per hour at 5 p. m., the time of its maximum force. By comparison with Galveston and Port Arthur it is readily seen that the sea breeze at Corpus Christi far surpasses the daily wind movement on the northern Texas coast. Comparison with places south of Corpus Christi has been impossible because of lack of data, but it is certain that no such wind velocities occur on the south Texas coast as those found near Corpus Christi.

While the average velocity of this breeze is remarkable, especially during the afternoon hours, the actual maxima attained are even more striking. Maximum velocities of 20 to 30 miles per hour, and sometimes higher, are frequent, due to nothing more than the natural flow of sea air landward. When accelerated by areas of low pressure in the interior, greater velocities are experienced. The regularity of this sea breeze is also remarkable; it is only during cloudy weather that it fails to be a fresh breeze.

The following tables show the average hourly velocities at Corpus Christi, Galveston, and Port Arthur during the three summer months of June, July, and August, and the average velocities at 10 a. m. and 5 p. m., the hours when the sea breeze has its average and maximum velocities, respectively.

TABLE 1.—*Average hourly wind velocity (miles per hour).*

	June.	July.	August.
Corpus Christi	14.2	13.3	13.3
Galveston	11.1	9.6	9.8
Port Arthur	9.2	7.7	7.1

TABLE 2.—*Average hourly wind velocity for 10 a. m. and 5 p. m.*

	June.		July.		August.	
	10 a. m.	5 p. m.	10 a. m.	5 p. m.	10 a. m.	5 p. m.
Corpus Christi	13	18	11	19	11	19
Galveston	11	12	8	12	9	12
Port Arthur	10	11	8	11	8	10

Period of observations in the above tables: For Corpus Christi and Galveston, 1911-21, inclusive; for Port Arthur, 1917-21, inclusive.

Tannehill[1] has shown that this high average wind velocity during the hottest part of the day in summer accounts for the deficient rainfall found on this coast, the continual movement of sea air landward with such great velocities preventing the formation of convectional thunderstorms upon which the summer rainfall mainly depends. It may be interesting to state that where this sea breeze begins to lessen, some 20 or 30 miles inland, thunderstorms are much more frequent than on the immediate coast. In the western part of Nueces County, near Robstown and Bishop, thunderstorms are relatively frequent during the summer months, and the formation of the thunder clouds can be plainly seen from Corpus Christi, and often thunder is heard, while clear skies are prevalent at the last-named place. Sometimes for several days in succession thunderstorms occur in the western part of the country while no rain falls on the coast. It is by no means an uncommon sight to see the air above Corpus Christi Bay perfectly clear, while convectional clouds completely cover the sky north and west of the station.

There are two causes for the increased sea breeze at Corpus Christi, viz:

1. The topography of the hinterland of Corpus Christi—a treeless plain, rising gradually and devoid of marshes.
2. The contour of the coast line at this point allowing the ocean air to reach the shore practically unimpeded.

Regarding the first cause of the abnormal sea breeze: To the north, west, and northwest of Corpus Christi lies a level prairie country, practically treeless, excepting scattered patches of mesquite. This plain increases gradually in elevation to the hilly country farther north. In the immediate vicinity of Corpus Christi for probably 30 miles inland is an ideal prairie land, about one-third under cultivation. There are no marshes in the vicinity.

When the sun's rays fall upon this plain it is heated abnormally, and there being no forests or marshes to absorb the heat or prevent its rapid radiation the natural consequence is an abnormal heating of the air immediately above. Isobaric surfaces are therefore unduly elevated, consequently the cooler ocean air flows in toward this area of barometric depression with great freedom, and of course the overflowing air from aloft assists in the circulation. On clear days the bare soil becomes so heated that this sea breeze continues far into the night, even after the time for the usual land breeze to begin. It is only on nights following days when the sea breeze has been usually weak that the typical land breeze asserts itself.

Regarding the second cause, which is of less importance: The curve in the coast line at Corpus Christi allows the southeast wind to strike the shore at such an angle that it meets with practically no resistance from a land surface before reaching the coast. It therefore comes over Corpus Christi with practically the same velocity that it has on the open ocean. To the south of this point the coast line is such that the east wind meets with

[1] I. R. Tannehill: "Wind Velocity and Rain Frequency on the South Texas Coast," MO. WEATHER REV., September, 1921.